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Farmstead Assessment System Worksheet #11 Site Evaluation

Why is the site evaluation important?

How farmstead practices affect groundwater depends in part on the physical characteristics of your farmstead site: soil type, aquifer characteristics, and depth to groundwater. That's why evaluating the soils and aquifer characteristics of your farmstead is such an important step in protecting the groundwater you drink.

What's involved in completing this evaluation?

This evaluation has four parts:

- Part 1: Evaluating your soil type and depth
- Part 2: Evaluating subsurface and geologic materials, along with depth to groundwater
- Part 3: Determining your overall site evaluation ranking (combining parts 1 and 2)
- Part 4: Drawing a farmstead diagram (optional)

To complete parts 1 and 2, you need to get information from outside sources, such as your county Natural Resources Conservation Service (NRCS) [formerly Soil Conservation Service] office, Natural Resources Conservation District (NRCD) office, UVM Extension System office, or Farm Services Agency office. How long this takes depends on the availability of the information in your county. Once you have the information, though, it should take about an hour to complete the first three parts of Worksheet #11. The farmstead diagram takes additional time.

If some of the information you need isn't readily available, the worksheet contains instructions on how to proceed. The more information you can get, the better; but some information is better than no information. The definitions on the last page may help you better understand some of the words that are used.

How do soils affect the potential for groundwater contamination?

Soil characteristics are very important in determining how a contaminant breaks down into harmless compounds or moves through soil and into the groundwater. Because most breakdown occurs in the soil, there is a greater potential for groundwater contamination in areas where contaminants are able to move quickly through the soil.

Sandy soils have large pore spaces between individual particles, and the particles provide relatively little surface area for sorption, or physical attachment of most contaminants. Large amounts of rainfall can percolate through these soils and dissolved contaminants can move rapidly down through the soil and into groundwater.

Clay soils, on the other hand, are made up of extremely small particles that slow the movement of water and dissolved contaminants through the soil. Contaminants also stick tightly to clay surfaces.

While held securely to soil particles, contaminants are broken down by bacteria and other soil organisms and by chemical reactions with minerals and natural chemicals in the soil. Most of this chemical and biological breakdown takes place in the loose, cultivated surface layers, where the soil tends to be warm, moist, high in organic matter and well aerated.

Finally, soil organic matter is important in holding contaminants. Soils high in organic matter provide an excellent environment for chemical and biological breakdown of these contaminants - before they reach groundwater.

The natural purification capability of the soil is limited. Under certain conditions, heavy rainfall and chemical spills may exceed the soil's purification capacity, allowing leaching to occur. In such cases, the subsurface geologic material and the distance a contaminant must travel to groundwater are important factors in determining whether a contaminant actually reaches the groundwater.

How do subsurface and geologic materials affect the potential for groundwater contamination?

Vermont soils were formed over sediments consisting of lacustrine (lake laid deposits), glacial till and outwash (ice contact deposits), weathered and disintegrated bedrock materials, organic deposits, recent alluvium (stream deposits) and bedrock. The depth of these surficial deposits ranges from zero to hundreds of feet.

Depth to groundwater is important primarily because it determines not only the depth of material through which a contaminant must travel before reaching an aquifer, but also the time during which a contaminant is in contact with the soil. As a result, where soil and surficial deposits are fairly deep, contaminants are less likely to reach groundwater. (This is not necessarily true if the soils and surficial deposits are saturated with water).

Bedrock geology influences groundwater pollution when the water table is below the bedrock surface. Sedimentary rocks have a wide range of permeability - from highly permeable fractured dolomite to nearly impermeable shales and crystalline formations. Very little of Vermont's bedrock is highly permeable. Most of the bedrock is fractured, which makes the prediction of pollution potential very difficult. Pollutants can readily spread over large areas in fractured bedrock and the direction of flow cannot be easily determined. Where bedrock material contains significant cracks and fractures, the depth and characteristics of soil and surficial geologic deposits largely determine the potential for groundwater contamination.

A word of caution

As with the results of the previous worksheets, use the rankings from this worksheet cautiously. Many factors affect whether or not a contaminant will get into the local aquifer. There is no guarantee that a "low-risk" site will be uncontaminated or that groundwater will become contaminated at a "high-risk" site. The type of contaminant involved, how you handle and store potential contaminants, the location and maintenance of your well, and many other factors can affect the potential for groundwater contamination.

Part 1: Evaluating the Soil on Your Farmstead

To complete your soil evaluation, you need a copy of your county's soil survey report. This report is available at most county NRCS, Natural Resource Conservation Districts (NRCD) or UVM Extension System offices. Some counties in Vermont have not been completely mapped and some have not been published in soil survey reports. The NRCS personnel can provide information to help complete this part, if that is the case in your county.

Step 1: Start by locating your farmstead on the aerial photos in the soil survey, note the soil map unit symbol or symbols that are in the delineations shown for your field, and read the full map unit description(s) in the text of the report.

If you have more than one soil mapping unit on your farmstead, rank each soil individually using this worksheet. If possible, transfer soil mapping unit boundary lines from the soil survey to your farmstead diagram sheet.

These rankings describe soil in native, undisturbed conditions. If your farmstead soil has been altered by human activities, such as excavation, filling, tilling or ditching, contact your NRCS office for assistance.

Don't skip any parts of the worksheet. If you are not familiar with using soil surveys, you may need help completing Part 1. Ask your NRCS/NRCD conservationist to help you find the following information:

Location of your farmstead on the map and aerial photographs provided in the soil survey report.

The soil mapping unit and soil series from the legend provided in the soil survey report.

The soil series and/or soil mapping unit, including the profile description, as well as any other information in the report regarding depth to bedrock, depth to water, or organic matter content.

The classification of the soil series, including family, subgroup, and order. Soil surveys published before 1965 will not include the soil classification. You will have to get this information from your county NRCS office.

Step 2: With the information in hand from Step 1, you are now ready to rank your soil(s) according to seven characteristics. For each of the seven characteristics in the left column, find information about your soil in the soil survey. Then, match your soil description to the description in the middle column to determine your score. (For example: If the soil survey indicates that the texture of one of your soils is a clay loam, the score for that characteristic would be 8.) Enter scores for up to 3 soils in the spaces indicated.

SOIL CHARACTERISTICS

For characteristics 1-7 that follow, consult the soil profile description and text, and the soil mapping unit text in the "Description of the Soils" section of your county soil survey.

		Score
1. Texture of surface (A horizon)	loam, silt loam, sandy clay loam, silt	9
	clay, sandy clay, silty clay, clay loam, silty clay loam	8
	loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam	4
	sand; loamy sand, sandy loam, organic materials (all "O" horizons), and all textural classes with coarse fragment class modifiers (such as "gravelly loam")	1

Your score(s) _____
soil #1 soil #2 soil #3
Score

2. Texture of subsoil (B horizon. If there is no B horizon, consider the character of materials within approximately 2 feet below the A horizon.)	clay, sandy clay, silty clay, silt	10
	sandy clay loam, loam, silt loam, clay loam, silty clay loam	7
	loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam	4
	sand; loamy sand, sandy loam, organic materials and all textural classes with coarse fragment modifiers (such as "gravelly loam")	1

Your score(s) _____
soil #1 soil #2 soil #3

3. pH of surface (A horizon)	6.6 or greater (the A horizon description will include one of the following terms: neutral, mildly alkaline, moderately alkaline or strongly alkaline)	6
	less than 6.6 (the A horizon description will include one of the following terms: slightly acid, moderately acid or strongly acid)	4

Your score(s)
soil #1 soil #2 soil #3

4. Depth of soil solum (depth of A and B horizons, minus inches of erosion from surface layer noted in soil survey description)	greater than 60 inches	10
	40 - 60 inches	8
	30 - 40 inches	5
	less than 30 inches	1

Your score(s)
soil #1 soil #2 soil #3

5. Soil drainage class	well drained	10
	well to moderately well drained	7
	moderately well drained	4
	somewhat poorly, poorly and very poorly drained; somewhat excessively and excessively drained	1

Your score(s)
soil #1 soil #2 soil #3

Score

6. Permeability of subsoil horizon	<p>a. If your soil series description indicates that bedrock is found within 20 inches of the surface, or if bedrock is present in the soil mapping unit within 40 inches of the surface, use the following ranking:</p> <p>bedrock at 20-40 inches</p> <p>bedrock within 20 inches</p> <p>b. For soils other than those listed in 6a, look in the family column of the Classification of Soil Series table. To determine permeability of the subsoil horizon, use the particle-size class in this column and find the rank for it below. If there is more than one particle-size class (such as fine silty over sandy or sandy-skeletal), choose the underlying material (such as sandy or sandy-skeletal). If your soil survey was published before 1965, see your NRCS office for assistance.</p> <p>Moderately low, low to very low (fine, very fine, clayey, clayey-skeletal)</p> <p>moderate (fine loamy, fine silty, coarse silty, loamy-skeletal)</p> <p>high (sandy or sandy-skeletal, coarse loamy)</p> <p>very high (coarse sand, fragmental, sandy, or psammentic suborder)</p>	<p>3</p> <p>1</p> <p>10</p> <p>8</p> <p>3</p> <p>1</p>
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Your score(s) _____
soil #1 soil #2 soil #3

A soil with more than 50 points (ranking #4) probably is a deep, medium or fine-textured, well-drained soil that contains 4 to 10 percent organic matter. Potential contaminants move slowly through the soil, allowing them to become attached to soil particles. Sunlight, air and microorganisms then have time to break down the contaminant into harmless compounds. The groundwater contamination risk level is low.

A soil with a score of 30 or less (ranking #1) is probably a coarse, sandy, extremely well-drained soil with less than 1 percent organic matter. Such a soil would allow most contaminants to move rapidly down toward the water table.

Overall, the higher your ranking number, the more likely that your soil conditions **will help to reduce** the risk of groundwater contamination from farmstead practices.

Part 2: Evaluating Subsurface and Geologic Materials on Your Farmstead

This part looks at the subsurface and geologic materials beneath your farmstead's soils. Completing the worksheet will give you a much clearer picture of your site's potential for keeping pollutants out of groundwater. For example, the soil evaluation might have indicated a moderate potential for protecting groundwater. However, if the soils are fairly thin and lie over fractured bedrock, the potential for groundwater contamination at the site is probably higher than indicated by the soil evaluation alone.

This part requires two items of information: (1) your site's subsurface geologic material and (2) depth to the local aquifer. Unfortunately, information on subsurface geologic material, as well as depth to water, is often difficult to obtain.

It is sometimes available from the soil survey report, although this differs from county to county.

You can also obtain this information from your well construction log, if one was prepared by the well driller. This information should be on file at the VT Department of Environmental Conservation, Water Supply Division, in Waterbury; telephone 802-241-3400. The well construction log will be filed under the name of the owner at the time the well was installed. The well driller may have a copy also.

You can find additional information from other well construction reports in your area, hydro geological reports and groundwater flow maps for some counties. These may be available from the U.S. Geological Survey. These are generalized groundwater maps, though, and may not accurately reflect the depth to groundwater or direction of flow at your farmstead.

Published geological reports may show the type of geologic material in your area. Try not to skip any steps in this part. Ask your UVM Extension agent, NRCS/NRCD specialist or Water Supply Division personnel to help you gather the information and provide assistance in completing Part 2.

Step 1: Find the information you need (from the soil survey, well construction logs, U.S. Geological Survey or the VT Geological Survey to identify (1) the geologic materials beneath your farmstead and (2) depth to groundwater.

Step 2: Match the information on your site's geology to one of the descriptions in the table that follows. You will be choosing **only one description** from the entire table.

If your well construction log describes more than two types of geologic material below 5 feet, ask for help in filling out this section from your UVM Extension office, or NRCS/NRCD office.

Step 3: When you have chosen the description that best matches your site's geology, read across to the right until you get to the appropriate "depth to local aquifer" for your site and circle that score for your farmstead.

For example, you may determine from your well construction log that geologic material beneath your farmstead consists of 30 feet of coarse-textured, unconsolidated material over fractured limestone, and that depth to local aquifer is 15 feet. Looking down the left column to find your category, and then going across to the right, you see that your rank is "1."

Subsurface Geology Table

Geologic Material (more than 5 feet below ground)	Depth to Groundwater (in feet)			
	0-10	11-30	31-50	More than 50
Fine-textured materials (more than 45' of materials)				
silt or clay	3	3	4	4
Glacial Till (more than 45' of materials)				
Dense or fine textured till (unsorted)	3	3	4	4
Medium to coarse textured till (unsorted)	1	2	3	4
Medium to fine textured, glacial till and unconsolidated materials over fractured bedrock				
33-45' of materials	2	2	3	4
21-32' of materials	1	1	2	3
6-20' of materials	1	1	2	2
0-5' of materials	1	1	1	1
Coarse-textured, glacial till and unconsolidated materials over fractured bedrock				
33-45' of materials	1	1	2	2
21-32' of materials	1	1	1	2
0-20' of materials	1	1	1	1
Sand and gravel (more than 45' of materials)	1	1	1	1
Karst, highly permeable or fractured rock (any thickness of materials)	1	1	1	1

There may be other situations that do not fall into the above categories. Determining a ranking for such situations requires a judgment call.

Step 4: Enter your circled number here: SUBSURFACE RANK_____

Step 5: The table below shows what your subsurface geology ranking means.

Rank	Level of Risk of Groundwater Contamination
4	Low
3	Low/moderate
2	High/moderate
1	High

A ranking of "4" shows that the subsurface material has the best potential to protect groundwater. This material has small pore spaces, groundwater is at least 10 feet from the soil surface, and the risk of groundwater contamination is low.

A ranking of "1" indicates a material with poor potential to protect groundwater. Its large pore spaces allow contaminants to move downward easily, increasing the risk of groundwater contamination. In highly fractured rock or in very coarse-textured, unconsolidated materials, the depth to groundwater doesn't seem to matter, because some contaminants will flow through the pore spaces with very little slowdown.

Overall, the higher your ranking number, the more likely that your farmstead's geologic conditions and depth to groundwater **will help to reduce** the risk of groundwater contamination from farmstead practices.

Part 3: Combining Your Farmstead's Soil and Subsurface/Geologic Rankings

Combining the rankings from parts 1 and 2 will provide you with a good overall ranking of your farmstead site's potential to keep pollutants from moving down to groundwater.

Step 1: Transfer your rankings from the soil evaluation (Part 1) and the subsurface/geologic evaluation (Part 2) to the appropriate place below:

Soil #1 Rank _____ Subsurface Rank _____
 Soil #2 Rank _____
 Soil #3 Rank _____

Step 2: The table below shows the overall level of groundwater contamination risk associated with your farmstead site conditions. Find your two numbers from step 1 **written in the correct sequence of "soils rank-subsurface rank"** and circle the sequence.

LEVEL OF RISK			
Low Risk (Rank 4)	Low-Moderate Risk (Rank 3)	High-Moderate Risk (Rank 2)	High Risk (Rank 1)
1-4	1-3	2-2	1-1
2-3	3-2	4-1	1-2
2-4	4-2		2-1
3-3			3-1
		3-4	
		4-3	
		4-4	

Step 3: Look above the sequence you circled to find your risk level and your ranking. (For example, if your numbers are 3-2 "soils rank-subsurface rank," your site is in the low-moderate risk column and your ranking is 3.)

Step 4: Enter your combined ranking here. (If you calculated more than one soils ranking, calculate a combined ranking for each soils ranking.)

COMBINED RANKING #1 _____
 COMBINED RANKING #2 _____

COMBINED RANKING #3_____

Step 5: Understand your combined ranking.

In general, a site with a combined ranking of 4 (low groundwater pollution risk) will have a soil with a good capacity to hold and break down contaminants. Its subsurface conditions will also keep contaminants from reaching the water table. Under certain conditions, however, such as spills, poor management, and heavy rainfall, contaminants may reach groundwater.

On the other hand, if you carefully manage a site with a combined ranking of 1 (high groundwater pollution risk), you may not affect your drinking water. **Both site characteristics and your management practices are of equal importance.**

Your three site ranking numbers (soils ranking, subsurface ranking, and combined ranking) will be used again in Worksheet #12. If you have more than one soil on your farmstead, you will need to transfer individual soil rankings and combined rankings to Worksheet #12. It will be especially important for you to complete Part 4 of this worksheet if you have more than one soil on your farmstead, so that you can match particular site concerns with each farmstead activity.

You may now proceed with Part 4 of this worksheet and develop a farmstead diagram, or you may go directly to Worksheet #12, "Overall Farmstead Assessment."

Part 4: Learning More About Your Site

Sketching a diagram of your farmstead can provide useful information to help you understand how the physical layout and site characteristics of your farmstead may affect the possibility of contaminants reaching your drinking water.

The diagram can show the location of wells, septic drainfields, manure storage areas, surface water, buildings, and other activities that may contribute potential contaminants. Along with the soil and subsurface evaluations, the diagram will help point out aspects of your farmstead that may present a hazard to your drinking water.

Step 1: Begin by looking at the sample diagram.

Step 2: Now diagram your farmstead on the graph sheet provided. Include all of the following that apply to your farmstead:

- all buildings and structures (home, barn, shed, confinement houses)
- wells and abandoned wells
- septic system (tank, absorption field)
- livestock yard, holding pens
- manure storage (temporary and permanent)
- underground petroleum storage tank
- above-ground petroleum storage tank
- pesticide and fertilizer storage, handling and mixing areas
- silage storage, feeding areas
- milkhouse waste disposal system (lagoon, tank, filter area)
- farm dumps
- vehicle maintenance areas
- manure disposal areas
- tiles, surface intakes, and open ditches

Use the same diagram to indicate surface water locations (ponds and streams), direction of land slope, different soil types, and groundwater flow direction if known. Generally, groundwater follows surface slopes and moves downhill towards surface water.

Step 3: Use your diagram to note which activities or structures on your farmstead have a greater likelihood of allowing contaminants to reach groundwater. This information should help prepare

you to make better decisions about your farmstead activities and structures and how they might be affecting your drinking water.

When you've completed the diagram of your farmstead, go on to Worksheet #12, "Overall Farmstead Assessment."

Glossary

Site Evaluation

Groundwater: Water that fills all the unblocked pores of underlying material below the water table.

Karst: An area of irregular limestone or dolomite in which erosion has produced fissures, sinkholes, underground streams and caverns with few surface streams.

Organic matter: Plant and animal residue in the soil in various stages of decomposition. Measured by organic carbon content.

Permeability: The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Includes such terms as very slow, moderate and rapid.

Soil classification: A shorthand system to provide detailed soil descriptions. Includes such groupings as order, suborder, subgroup and family.

Soil drainage class: The frequency and duration of periods of saturation or partial saturation that existed during the development of the soils, as opposed to human-altered drainage. The seven classes of natural soil drainage include excessively drained, well-drained, moderately well drained, somewhat poorly drained, poorly and very poorly drained.

Soil horizon: A layer of soil, approximately parallel to the surface, that has distinct characteristics, such as color, structure and texture. Described in shorthand form by letters such as A, B, and C.

Soil mapping unit: A soil or combination of soils delineated on a map and, where possible, named to show the taxonomic unit or units included.

Soil series: The basic unit of soil classification, consisting of soils that are essentially alike in all major profile characteristics.

Soil texture: The relative amount of sand, silt and clay particles in a mass of soil. Basic textural classes, in order of increasing proportion of fine particles, range from sand to clay.

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Revisors: Craig Altemose and William Jokela, UVM Extension; Jon Anderson, VT Natural Resources Conservation Council; Don Hipes, Winooski NRCD; Arthur Webb, Franklin Co. NRCD.

Technical reviewers: Steve Gourley, Soil Scientist, NRCS; Laurence Becker, State Geologist, VT Geological Survey, Agency of Natural Resources.

Coordinator: Ben Gabos 1-802-229-2720

Steering Committee: Craig Altemose, University of Vermont Extension; Jon Anderson, VT. Natural Resources Conservation Council; Lynn Blouin, Franklin County Natural Resources Conservation District; Sid Bosworth, University of Vermont Extension; Gail Center, VT. Department of Health; Jeff Comstock, VT. Dept. of Agriculture, Food & Markets; Rob Farley, VT. Department of Environmental Conservation; Don Hipes, Winooski Natural Resources Conservation District; Elizabeth Hunt, VT. Department of Environmental Conservation; Dan Koloski, USDA Natural Resources Conservation Service; John Miller, VT. Department of Environmental Conservation; George Mills, VT. Department of Health; Pauline Pare, USDA Natural Resources Conservation Service; Heather Ploski, Winooski Natural Resources Conservation District; Ellen Sivret, USDA Natural Resources Conservation Service; Bill Snow, University of Vermont Extension; Barbara Ann Trowbridge, USDA Farm Service Agency; Art Webb, Franklin County Natural Resources Conservation District.

Word processing: Don Hipes, Winooski NRCD.

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